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SUMMARY OF THE DOCTORAL DISSERTATION

**Surface modification of semiconducting nanoparticles for applications in sensors**

Semiconducting nanoparticles (NPs) possess specific optical properties influenced by their size and structure (quantum dots, nanorods, nanoplates). Through appropriate manipulations during the synthesis, cadmium-based NPs (e.g. CdS, CdSe, CdSe/CdS, CdSe/ZnS) with unique optical properties, i.e. broad absorption band (several hundreds of nm), narrow emission band (below 40 nm), high quantum yield (up to 95 %), possibility of emission band tuning over a wide range of wavelengths (350 – 2000 nm), can be obtained.

High-quality NPs are usually synthesized as hydrophobic structures possessing an ability to disperse in organic media. However, the use of NPs in various fields of science, especially in biology and medicine, requires dispersion in an aqueous medium. To achieve that, surface modification (functionalization) of NPs is necessary. This process is based on the binding of (or replacing) chemical or biological molecules to the surface of NPs.

The main goal of the doctoral dissertation *Surface modification of semiconducting nanoparticles for applications in sensors*was to effectively modify the surface of cadmium-based nanoparticles (of various sizes and shapes), giving them new properties, mainly hydrophilic.

As a result of the research, the ligand exchange process was optimized with the use of thiol-derivative molecules. This allowed to determine the stability of hydrophilic NPs in a wide pH range and to study the influence of pH on their intensity of photoluminescence.

The influence of the application of the inverse ligand exchange reaction on two-dimensional nanostructures was also investigated. The NPs obtained in this experiment showed high photoluminescence emission (about 90 %), and the research report was reported as a new method of obtaining blue-emitting quantum dots.

The concept of a matrix grounded on cadmium-based hydrophilic quantum dots, with the enhanced emission by the use of sodium chloride, for the determination of cortisol was presented. The idea behind the matrix's operation was to extinguish the photoluminescence emission with the increase of cortisol concentration in the solution. Obtained results, although promising, require further analysis and improvement of the detection system.

The research carried out as part of this dissertation allowed to understand the process of surface modification of cadmium-based nanomaterials. This knowledge could enable the optimal design of fluorescent probes for the detection of biomolecules, where NPs hydrophilicity, photoluminescence stability, and activity over a wide pH range are required. In addition, obtained nanoparticles with blue emission can be used in the construction of LEDs or in displays based on quantum dots.